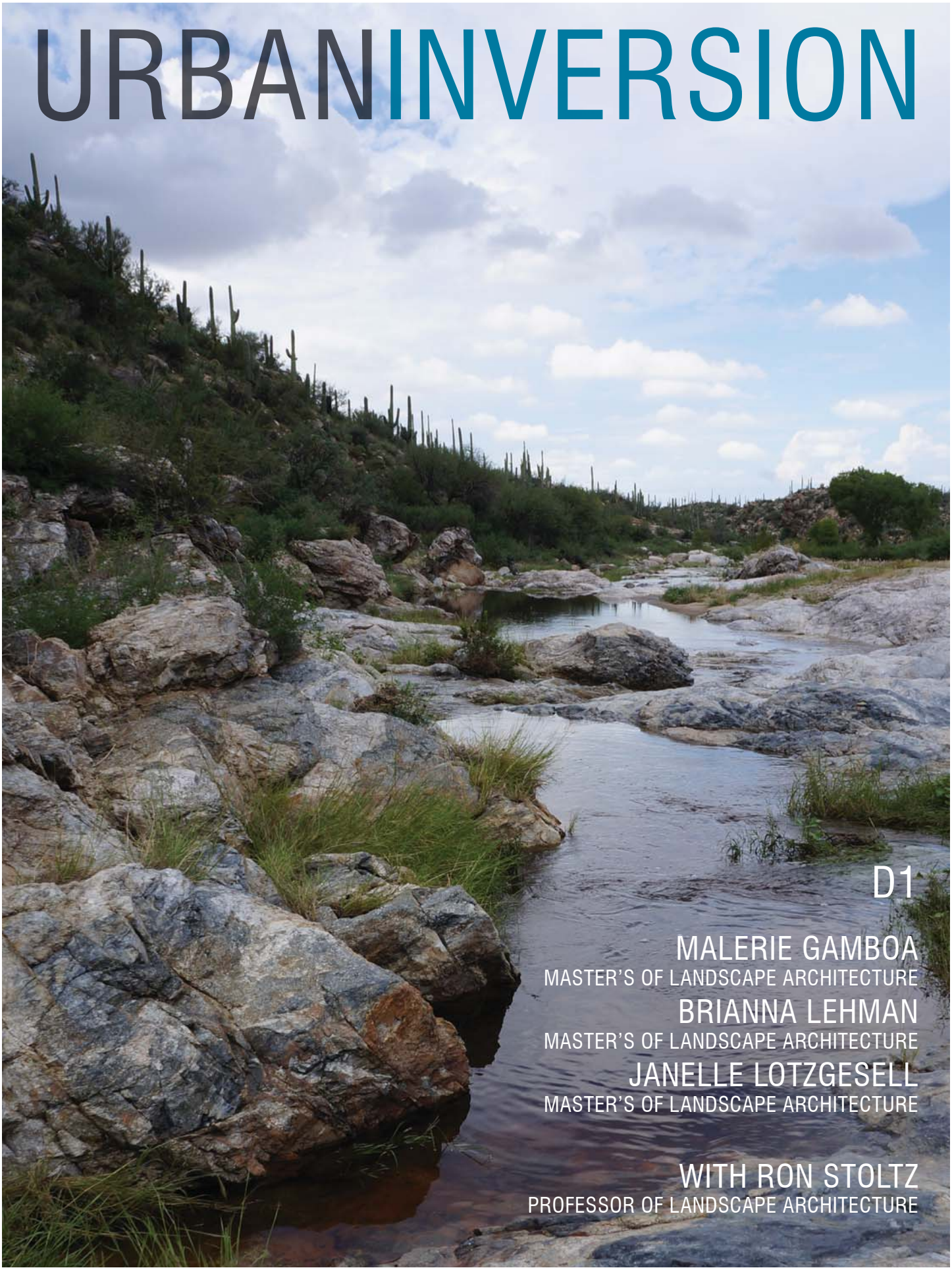
URBANINVERSION



D1

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PROJECTINTRODUCTION

Urban Inversion is a project that seeks to reclaim a small campus parking lot at the University of Arizona, reestablishing a small piece of the Sonoran Desert into a very urbanized piece of Tucson that is currently disconnected from the desert landscape that surrounds it. This project accomplishes that goal through the establishment of a campus green space in the previously paved parking lot, creating recreational and educational opportunities while also serving as a contained hydrological system, drawing water from nearby sources and detaining them on-site, minimizing urban flooding in surrounding neighborhoods, while utilizing these hydrological resources to create a dynamic, exciting destination that captures the spirit of the surrounding Sonoran Desert.

CAMPUS FLOODING

PROJECTABSTRACT

Urban Inversion seeks to create an identity for the University of Arizona as a unique desert campus, connected to and respectful of the Sonoran Desert that surrounds it, acknowledging the unique ecology and environmental constraints of the harsh desert environment while celebrating and fostering understanding of the unique conditions and attributes of this arid land. By converting a previously impermeable, thermally massive parking lot to a focal green space accessible by students and community members, the northern part of campus becomes an essential locale for recreation and educational opportunities. Additionally, the design addresses the eminent concern for urban flooding by managing runoff that occurs onsite and immediately adjacent in a way that facilitates detention, use and storage. The multiple opportunities for engagement and interaction make Urban Inversion a dynamic, exciting destination that captures the essence of the Sonoran Desert.

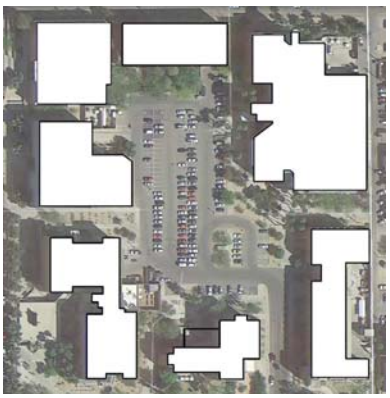
THE LIBRARY CATWALK

RESEARCHPHASE

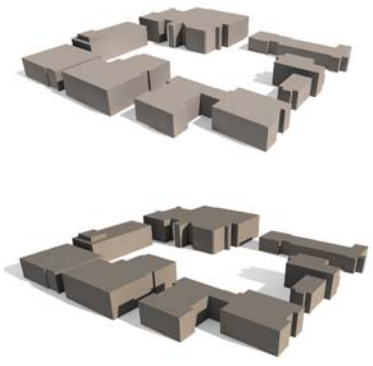
A tour was undertaken through various water-harvesting projects across the University of Arizona campus. Additional projects were viewed in neighboring Phoenix, ascertaining the unique conditions and responses to water management in the arid desert Southwest. Although water-harvesting strategies are practiced elsewhere, the desert has a unique set of conditions, and this allowed the opportunity to evaluate the successes and challenges of real-world projects in an arid environment.

SITEANALYSIS

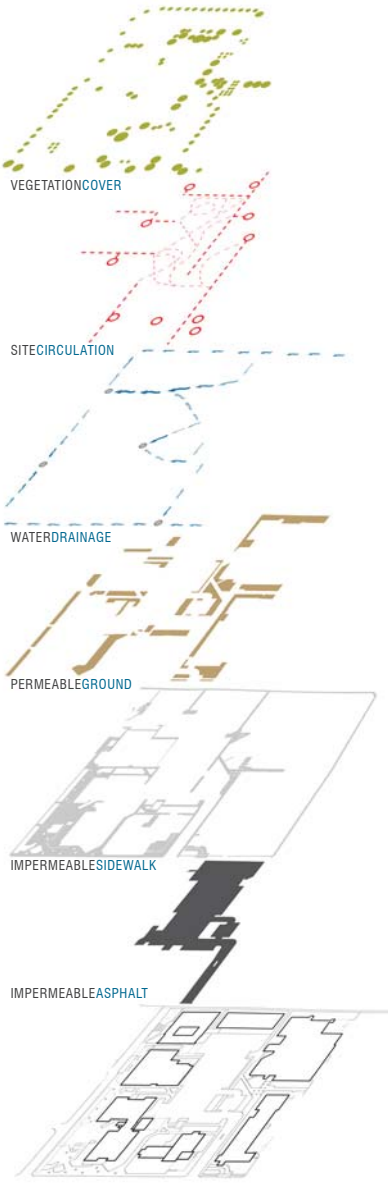
Site analysis was undertaken to understand the current movement of the water onto and around the site, as well as other mitigating conditions, such as temperature and solar exposure. The University of Arizona has historically exercised a stormwater management regime that directs surface water off campus, resulting in urban flooding of surrounding neighborhoods. In addition to stormwater, other water resources include discharged water from an immediately adjacent building and potential air conditioning condensate. As it stands, there is almost no solar mitigation across the entire site, leaving a large swath of land subject to harsh, penetrating exposure. A specific shade study was undertaken to ascertain the solar conditions on the site, as it is intended to support a large gathering of students and other community users throughout all times of the year. The situation of the site between Fine Art, Photography, Engineering, and Speech and Hearing buildings informs the circulation of people and vehicles accessing the various buildings.



EXISTINGCONDITIONS



SHADOWSTUDY



ANALYSISDIAGRAMS

CONCEPTDEVELOPMENT

Following the site analysis phase, conceptual ideas exploring parking, the built environment, the desert, various water movement systems throughout the southwest, and the expansion of the built environment in Tucson after the Second World War were revealed in a series of conceptual models. These conceptual designs went through a series of iterations, evaluating the pros and cons of each of the concepts, weighing the appropriateness of their response to the project goal, and then expanding on those lessons to develop the next conceptual phase. Three final concepts were reached: The Oxbow, which references the geomorphological oxbow characteristic of western rivers, most visibly in the Colorado River; Undulations, which addresses the straight and flat nature of the built environment in Tucson, the concept maintains the circulation at grade for accessibility but allows the land form around it to move up and down, capturing and directing stormwater from the built environment; and Urban Inversion, which attempts to re-establish a piece of the Sonoran Desert landscape in the heart of the city, creating a gradient between the built and the natural environment and the xeririparian to the riparian desert environment while capturing and interpreting stormwater in an artful way.

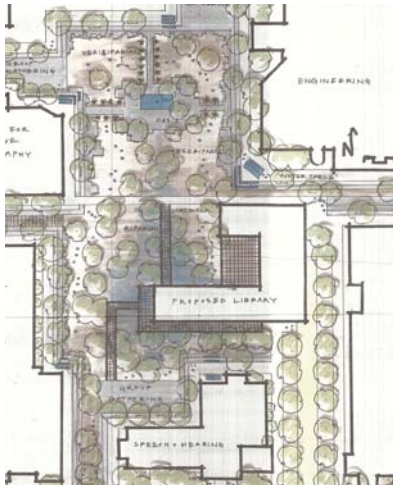
Each of the three concepts proposed a library as an integral part of the design; most green space projects with the University of Arizona are undertaken as part of a larger building plan, and a library has been proposed for this site as part of the University's general plan. An interim review addressed these three concepts, and received feedback from a panel of professionals, including a professor of landscape architecture, the University of Arizona campus Landscape Architect, a water resources expert, and a representative from campus facilities. Responding to the feedback from this interim review, the next stage in the design process was the simultaneous final concept development and proof of concept calculations.

CONCEPT1 | THE OXBOW

+ MAKES WATER MOVEMENT VISIBLE
+ LIBRARY IS INTERACTIVE WITH WATER
- LIMITS CIRCULATION PATTERNS
- LIBRARY FORM DIVIDES SPACE
+ DRAWS FROM REGIONAL INFLUENCES

CONCEPT2 | UNDULATIONS

+ LANDFORM PIQUES INTEREST
+ CIRCULATION ALL AT GRADE
+ BUILDING RESPONDS TO CLIMATE
- TECHNICAL CONSTRAINTS
- LIMITS CIRCULATION PATTERNS



CONCEPT3 | INVERSION

+ EPHEMERAL POOL ADDS INTEREST
- CIRCULATION LIMITED
+ ICONIC INTERPRETIVE ELEMENTS
+ VARIETY OF PLANTING DENSITIES
- LIMITED BIKE ACCESS

PROOFOFCONCEPT

After clearly identifying the strengths and weaknesses of the various concepts that were presented during the interim review, the next stage in the development of the final concept was to fact-check the volumes of water received and storage proposed, and to relocate specific elements and functions based on the numbers reviewed. Our process was as follows:

- Calculate the roof area of each of the immediately adjacent buildings in acres (A)
- Calculate the roof area of the proposed library building, which included a green roof on two of the segments (A)
- Calculate the area of remaining ground plane, with the assumption that any hard surfaces are designed and constructed using permeable paving (A)
- Assume the following coefficients of runoff (C):
  - Roof: 0.95
  - Green roof: 0.45
  - Ground plane: 0.20
- Calculate the rainfall intensity in inches per hour (i) for a 2-year and 25-year storm where i=k/(t_c+b)
  - 2-year storm
  - i=68/(30c+14) = 1.55 inches per hour
  - 25-year storm
  - i=155/(30c+26) = 2.77 inches per hour
- Calculate the peak runoff rate in cubic feet per second (Q), where Q=CiA
- Convert calculated Q values for each runoff type to represent a 20 minute storm, where peak runoff in 20 minute storm=(Q)(60 seconds)(20minutes)
- Divide the 20minute storm peak runoff by 2 for each of the immediately surrounding buildings
- Add the peak runoff values of immediately surrounding buildings, proposed library building, and remaining groundplane to find total runoff during 2-year and 25-year storms
  - 2-year storm peak runoff=3,126 ft^3 or 23,382 gallons
  - 25-year storm peak runoff=9,513 ft^3 or 71,157 gallons
- Finally, add the 3000 gallons of discarded microchip washing water from the adjacent engineering building to the peak runoff amounts of both storm events to show the maximum water detention capacity planned for
  - 2-year storm total water= 23,382 + 3,000 =26,382 gallons
  - 25-year storm total water= 71,157 +3,000 = 74,157 gallons

These calculations informed the physical design of water catchment areas—the ephemeral pool and bioswales—in addition to the size proposed for the cistern. Conceptually, this design is intended to capture all of the above rainfall, direct it within the site, and allow it to either percolate and recharge or fill the 100,000 gallon cistern installed as a backup measure to store excess water.

FINALDESIGN

As an iconic and compelling campus resource, the final design of Urban Inversion exhibits regard for its desert context and exemplifies the University's unique position to advance understanding and appreciation of water resources in arid climate. The goals and objectives of the design are as follows:

GOAL: Integrate the Sonoran desert landscape into the homogenized, urban campus environment.

- Use a native planting palette to demonstrate appropriate water use while highlighting and interpreting the unique and beautiful desert landscape.
- Use native plants and landscape features to mitigate the adverse effects of urbanization in Tucson's desert climate.

GOAL: Create an interactive space where the ephemeral nature of water intrinsic to the Sonoran landscape is celebrated and made explicit and visible.

- Install a bubbler that uses historically discarded water from an immediately adjacent building to produce intermittent flows into an accessible ephemeral pool, creating a dynamic, immersive experience.
- Move stormwater, air conditioning condensate and reused water within the site through the use topological features to create unique, comfortable spaces that are characteristic of the Sonoran Desert.

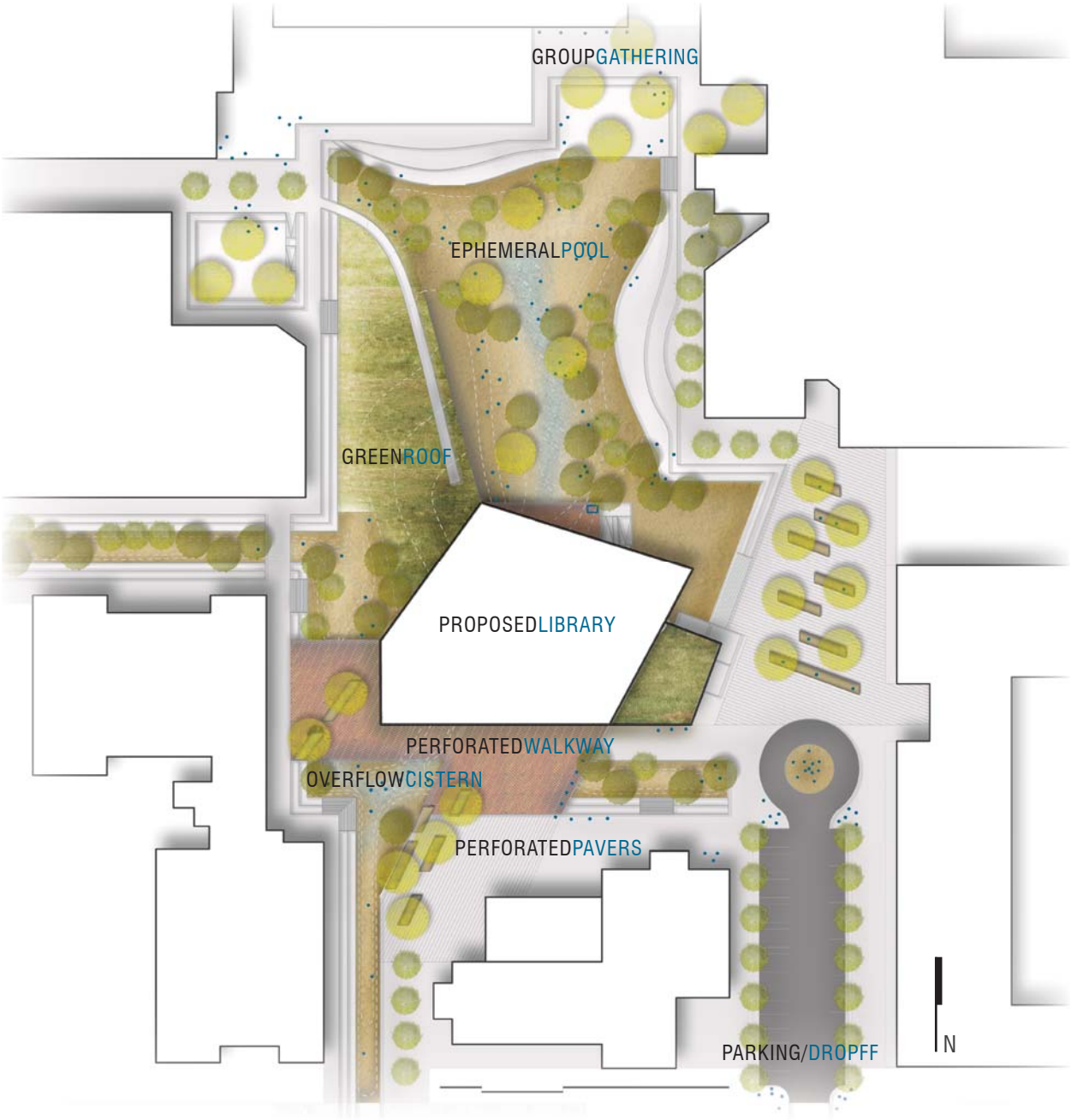
GOAL: Manage storm water, condensate, and previously discarded water on-site, reducing the reliance on municipal systems and promoting a self-sufficient environment.

- Reverse historic trends of urban flooding in surrounding neighborhoods caused by the University by directing surface flows inward onto the site and detaining overflow.
- Use and reuse captured water for a variety of services including interpretation, irrigation, plumbing, and storage.

GOAL: Use interpretive elements to demonstrate the significance of water in the desert and foster educational engagement.

- Install visual way-finding devices that serve as artistic and interpretive elements to create a visual identity that provokes emotional and intellectual engagement.
- Use a gradient of edge conditions as an interpretive mechanism that represents the transition of environments from urban to natural.

CONCEPTUALPLAN



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EPHEMERALPOOL

The focal feature of this design is the ephemeral pool. Situated in the northeast section of the site, it uses the 3000 gallons of water discarded every day from the adjacent engineering building and reroutes it from the city stormwater system into a cistern that is stores it until it is released into the detention area through a bubbler box as it reaches the tipping point. This design element serves two primary purposes: it reflects the temporal nature of water in the desert, and it transforms the site into an area of interest and intrigue, attracting visitors at all times in hopes of being witness to the dynamic, ephemeral presence of water.

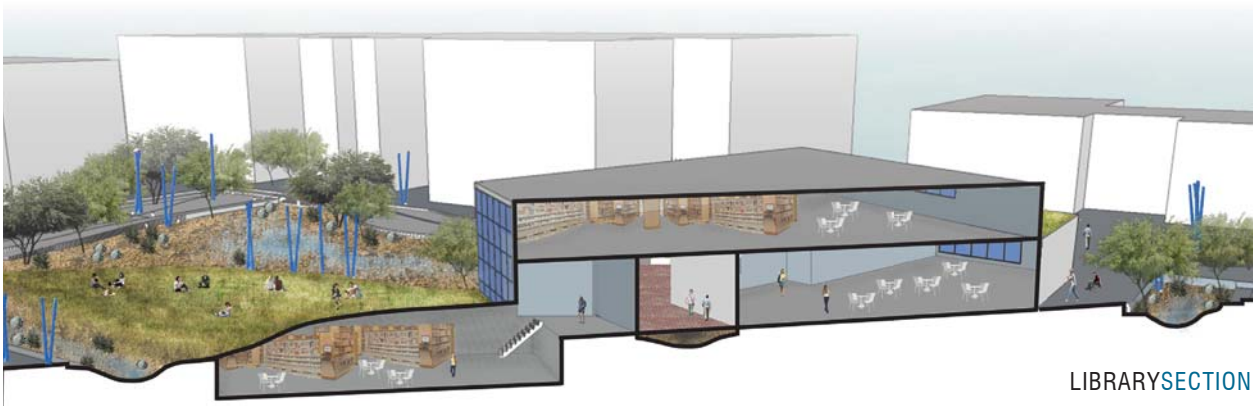
SPRINGEPHEMERAL

SUMMERDRY

MONSOONFLOOD

PROPOSEDLIBRARY

One of the challenges of designing within this space was to respond to the scale of the immediately adjacent buildings. As the conceptual framework suggests, this design aimed to blur the boundaries between built and natural elements, so responding the adjacent scales was accomplished by both proposed building and natural elements. The proposed library building offers a solution that is fully integrated into the context, with a sunken level that mitigates the need for air conditioning and with a breezeway above a water channel that creates a cool, comfortable circulation corridor. The sunken level of the library allows for a green roof to be installed on its surface, which is proposed as a berm on the exterior ground level. This berm serves three purposes: an area of turf on campus that is a requisite of proposed open space per the University Master Plan; a raised platform for viewing movies and other projected installations onto the adjacent blank building wall, and; a learning lab for green roofs in desert environments that can be used as an active example for the architecture and landscape architecture programs immediately adjacent.



LIBRARYSECTION

ARTINSTALLATION

Another key feature of this design is the blue pole installations. These 140 poles installed throughout the site represent the estimated 140 feet of loss to the water table over the past 50 years in the City of Tucson, which coincides with the rapid population growth that was brought about in the post-war period. Some poles stand alone, acting as wayfinding devices throughout the site, bringing visitors in contact with where the water might be, whereas others are clustered at crucial points within the landscape to serve as landmarks to reach buildings and other amenities. The installation promotes interpretation, education, and introspection, and brings attention to the loss of groundwater in Tucson, further highlighting the importance and ephemerality of water in the desert.

UNIVERSALACCESSIBILITY

Changing landform was a key element to the technical success and engagement of this site. The manipulated topography is essential to directing water and creating spaces that are unique and intriguing. In making such bold moves, it was critical to maintain legible, universal access throughout the site. This design takes into consideration the multiple abilities of students and visitors, and, responding to one of the key goals of interaction, it effectively facilitates movement within the various elements of the design. There are ramps and stairs where necessary to move visitors between the various topological undulations, while many of the primary entry, exit, and circulation paths are maintained on a constant level. Sensitivity to access and consideration of uninterrupted and easy interaction with the site features was crucial to the final design layout.

PLANTINGPALETTE

Plant selection in the desert provides a unique opportunity to express the character of the desert, the choice to use limited water resources responsibly, and respond to the context of the environment. Urban Inversion uses the plant palette to bring the Sonoran Desert into the heart of the campus by installing only plants that are native. This provides added benefit in the form of wildlife habitat for native fauna. Additionally, plantings are installed in a way that mimics the ecological patterns of the desert, primarily echoing arroyos and ephemeral pools.



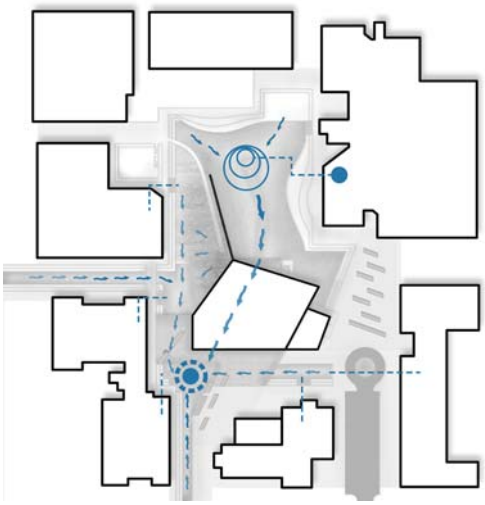


DEVELOPMENTGRADIENT

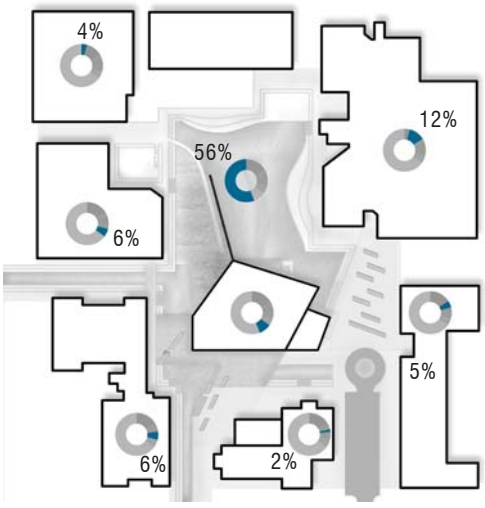
Further highlighting the inversion of the natural environment into the built context is the gradient applied to the edge conditions of the site. The edges of immediately adjacent buildings were the source from which the gradient begins, informing the shape of the outermost layer of built/natural gradient. Gradually, as the user moves inward toward the center of the site, the environment becomes more and more natural, with an absence of hard edges and built elements. This immersion forces the visitor to recognize and interact with the desert when they otherwise would not have had the opportunity within the urban context of Tucson.

HYDROLOGYMANAGEMENT

In order to make this design successful, there are a variety of amendments to the current water management infrastructure. These changes allow water to be utilized and directed to the various elements of the design in a way that limits the system's reliance on built infrastructure and allows natural flows to dictate the hydrologic process. The water sources used in the design consist of stormwater flows from the roofs of immediately adjacent buildings as well as surface flow - condensate collected from the air conditioning unit of the proposed library building – as well as microchip washing water.



WATERCIRCULATION



WATERCONTRIBUTION

The proposed hydrological system is contingent upon the installation of a cistern in the engineering building that will capture and hold the micro-chip washing water that is currently being discarded into the city stormwater system. From this cistern, a period release of contents would direct the water into the bubbler that is installed in the northeastern portion of the site, where a large, shallow detention basin will fill then drain into the bioswales downstream. This flushing and flooding mechanism is what creates the ephemeral allure of Urban Inversion. During these ephemeral events, as well as during storm events, water will be directed from the edges of the site toward the detention basin in the northeast or the microbasins along the western edge. Water in these bases flows southwesterly, either along the side or between the library building, until it reaches an infiltration area in the southwestern corner of the site. Here, any excess water that remains and is beyond the capacity of the microbasins will be directed into a 100,000 gallon cistern below ground. Installing this cistern is

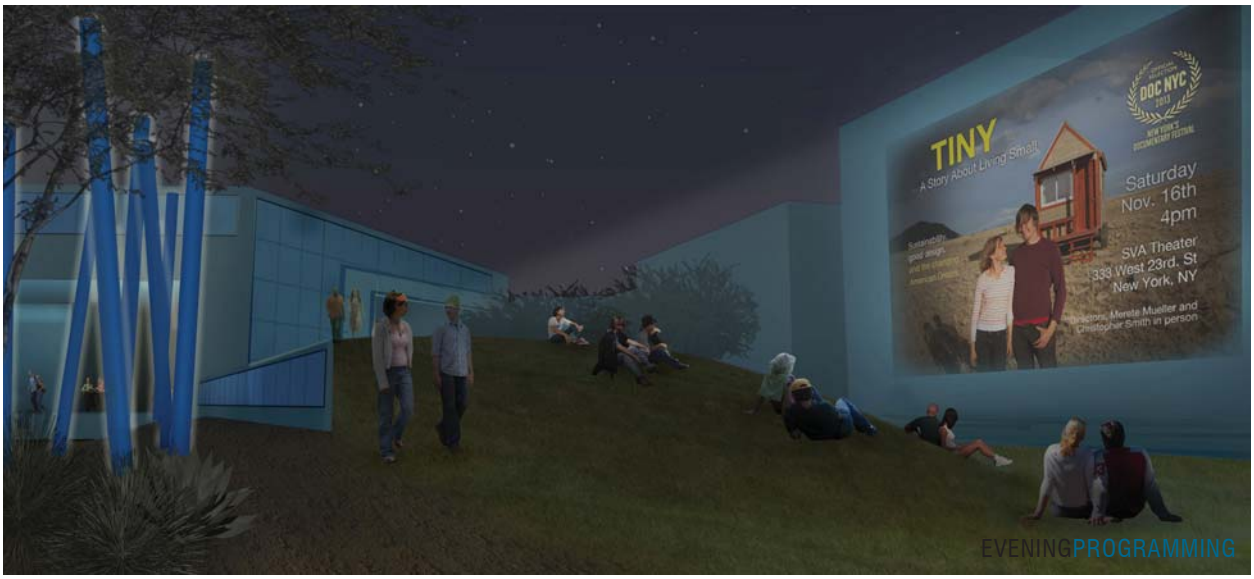
a method of control to fulfill the goal of reducing urban flooding, and creating a self-sufficient environment. Water captured in the underground cistern will be used for either irrigation, plumbing in the proposed library building, or storage.

ANTICIPATEDOUTCOMES

The anticipated outcomes for this project vary from the social to the environmental. By creating a campus green space that incorporates a library and gathering area, a sense of community will be created for an area of campus that lacks a specific identity. A series of disparate gathering areas are appropriate for outdoor classrooms, events, and social interaction. These green spaces will also serve as destination for the surrounding community, which currently lacks a sufficient amount of green space.

Environmental outcomes include a reduction in the amount of urban flooding in surrounding neighborhoods as well as the University of Arizona campus, and an increase in available stormwater for the site to utilize for landscaping, graywater flushing, and other needs. The increased planting cover, as well as a decrease in the amount of permeable, reflective surfaces will contribute to a reduction in the urban heat island effects throughout the site.

The least tangible but most important aspect of this site is the ability to educate and inspire the surrounding community to appreciate the native desert environment, and to conduct their lives in a way that respects and preserves this unique habitat for future generations.



EVENINGPROGRAMMING